

Andrew Gelman’s contribution to the discussion of “Bayesian Statistics in Scientific Induction: A Decision Analysis Perspective” by Simon French

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It was once said that the development of the organism follows the path of the historical development of the species. This principle of "ontogeny recapitulates phylogeny" is no longer believed in biology, but I would argue that some version of such a principle applies in statistics, that a good statistical analysis is likely to recapitulate the historical development of statistics, starting with data and simple distributions, moving to comparisons and linear models, through nonlinear interactions and adjustments, to integration with related data and problems, up to the current state of the art of models that can be fit only iteratively and understood only through their predictions.

French discusses some of this in his article, and my own views have changed over time too; in particular, I have become more "Bayesian" over the years, in the sense of being more willing to use informative priors and less tolerant of inferences based on noninformative priors which have been misleadingly labeled as "conservative" (Gelman and Jakulin, 2007).

Regarding French's comments on the history of Bayesian statistics during the twentieth century and beyond, I would just add that there is a corresponding history of anti-Bayesianism (see Gelman and Robert, 2013). The development of Bayesian ideas is in part a response to the development of anti-Bayesian attitudes—and vice-versa.

Regarding French's discussion of various sources of uncertainty, I like to think of any empirical probability as not just a number but as part of a network of conditional statements. For example, if I flip a coin, the probability it lands heads is 1/2. And if two candidates are fighting an election in a country I know nothing about, I can assign a 1/2 probability to each winning. The first is a physical probability; the second represents uncertainty. The resolution is to consider each of these events within a larger context (or, as we might say, in a hierarchical model). You could imagine taking measurements on the coin and performing preliminary flips, but none of this information is likely to budge $\Pr(\text{heads})$ far from its marginal value of 1/2. In contrast, with the election we could gather historical data, conduct polls, etc., and the win probabilities could shift a lot. Thus, two different networks of conditional distributions that have the same marginal distribution, and this is a way of instantiating the difference between aleatoric and epistemic uncertainty without leaving the conceptual framework of standard probability theory.

References

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